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ABSTRACT

As a cooperative project of Tel Aviv University, the University of Wisconsin, and Stanford University, four separate studies on reading were conducted in the 1970-71 school year with kindergarten and first grade Israeli students. The first study was the development of a prereading skills test consisting of picture vocabulary, word memory span, letter and letter-string matching, alphabet recognition and production, and rhyming subtests. The second study was a test of different instructional procedures for teaching picture-sound associations using Hebrew speech sounds as responses, and the third and fourth studies explored sound matching and syllable blending. Full reports of the procedures, materials, and results of each study are given, as well as implications for further studies in Israel and the United States. (TO)

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Technical Report No. 227

STUDIES OF PREREADING SKILLS IN ISRAEL

by

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Report from the
Basic Prereading Skills Component of
Program 2: Development of Instructional Programs

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Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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Introduction

The studies described here were designed and carried out during the 1970-71 school year as a cooperative project of Tel Aviv University, the University of Wisconsin, and Stanford University. Funding for this work was provided through all three universities, plus the General Education Corporation of Israel. The goal of this work and of parallel projects at the University of Wisconsin and Stanford University is the improvement of reading instruction through early diagnosis and instruction in basic prereading skills. A theoretical and methodological basis for this approach can be found in Calfee, Chapman, and Venezky (1970) and Venezky and Chapman (1971). Studies done in Israel were directed toward both the development of an Israeli prereading skills program and toward cross-cultural comparisons of reading and reading failure. The Israeli program is being carried out under the general supervision of Professor Micha Chen of Tel Aviv University with the cooperation of Mrs. Netza Naftali, director of kindergartens for the Ministry of Education and Culture in the State of Israel.

The subjects for all of these studies were drawn from kindergartens in predominantly lower and lower-middle socioeconomic areas (Petah Tikvak, Amishav), with a high proportion of the parents being immigrants from the Oriental countries: Yemen, Iraq, and North Africa. All of the children and most of their parents spoke Hebrew, and most of the parents were literate, although the amount of formal education which they had received averaged less than eight years of elementary school. The first grades were drawn from both upper and lower socioeconomic areas (Petah Tikvah, Rimon, Kyriat Ono, and Savyon).

Four separate studies were done with these subject populations. The first was the development of a prereading skills test, consisting of separate subtests for picture vocabulary, word memory span, letter and letter-string matching, alphabet recognition and production, and rhyming. This test was administered to four kindergartens in both the fall and spring of 1970-71, and to the first grades in the fall. Reading scores on two different reading tests were obtained in the spring for these same first graders.

The second study was a test of different instructional procedures for teaching picture-sound associations using Hebrew speech sounds as responses, and the third and fourth studies explored sound matching and syllable blending. The results of these studies are reported here, along with the plans for the 1971-72 year.

1
Prereading Skills Tests

R. Venezky, Y. Shiloah, and R. Calfee

Introduction

The purposes of prereading skills tests are twofold: first, to diagnose deficits in prereading skills at a preschool or kindergarten level so that appropriate instruction can be provided prior to the time the child begins formal reading instruction; and second, to predict at the end of kindergarten or the beginning of first grade which children will have difficulties in learning to read so that the first-grade teacher can be prepared to group them for special assistance. Studies of instructional techniques for prereading skills are already underway for kindergarten (see the Discussion section), so that eventually the prereading skills test will be a component of a complete program which diagnoses deficits in prereading skills at the beginning of kindergarten and provides instruction in each skill for those who need it. (For information on a similar program now in use in the United States, see Venezky, Chapman, Seegal, Kamm, & Leslie, 1971.)

Selection of Skills

The major criteria for selection of prereading skills were (a) that the skills be related directly to either the reading process or learning to read and (b) that the skills contribute significantly to a multiple correlation with reading ability. But since no data were yet available in Israel on basic prereading skills at the kindergarten level or on predictors of reading success at the kindergarten or early first-grade levels, a variety of skills were sampled, either according to these criteria or according to studies of reading in other societies. The six skills which were sampled during the 1970-71 year were:

1. Picture vocabulary
2. Immediate memory span for words
3. Alphabet memorization (alphabet production)
4. Letter naming (alphabet recognition)
5. Letter and letter-string matching
6. Rhyming

In the discussion which follows, each test is discussed in terms of (a) adequacy as revealed by score distributions, (b) reliability as measured by part-whole correlations, (c) independence as measured by correlations with the other tests, and (d) validity as measured by the test's contribution to a multiple correlation with first-grade reading scores. For each of factors a, b, and c, both a kindergarten and a first-grade sample will be discussed; for factor d, only the first-grade sample applies.

Method

Procedure

All Ss were tested individually on the six subtests at the beginning of the school year by one of three experimenters. Kindergarten Ss were tested again in the late spring on the same six skills, but were given alternate forms of all tests except the two alphabet tests. First-grade Ss were given two different reading tests at the end of first grade: the Ortar test of word, sentence, and paragraph comprehension; and the Kidron test of syllable, word, and sentence recognition.

Subjects

The subjects were 108 kindergarten children in four kindergarten classes and 80 first

graders selected from four first-grade classes. The distribution of subjects by class and sex is shown in Table 1.

Testing Materials

Picture vocabulary. Two parallel forms of a picture vocabulary test were developed, with each consisting of 16 outline drawings of common objects. Three practice items preceded each list. Children were shown one picture at a time and asked, "What do you see in this picture?" Responses were scored as correct, incorrect, or related (e.g., chair for bench). Vocabulary words were selected on the basis of a published frequency list of basic Hebrew words for elementary schools (Balgur, 1968) and a recent questionnaire survey of kindergarten teachers, done for this study.

Word memory span. Two parallel forms of the word memory span test were developed, each consisting of ten word-strings. On each test the first four strings were of lengths three, four, five, and six words, respectively, with unrelated words within each string. The remaining six strings were pairs of lengths four, five, and six words; one of each pair consisted of obviously related nouns or adjectives and the other contained nouns or adjectives of a less obvious relationship. Two warm-up strings preceded each list. Words were selected from the same lists used for picture vocabulary.

Children were instructed to repeat the word strings as they heard them; words were presented at a normal reading rate. The total number of words correctly repeated, regardless of order, was recorded. If any words were missed, a second try was given and both scores recorded.

Alphabetic production. Children were asked to recite, without visual props, the names of any of the letters of the alphabet. Each correct name was recorded; nonletter names were ignored.

Alphabetic recognition. Children were shown printed Hebrew letters (not including the five word-final variants) in random order and asked to give the name of each. Responses were scored as correct, incorrect, and no response.

Letter matching. Two parallel forms of a letter-matching test were developed, each form consisting of 20 test items. Within each test item were a standard, which occurred on the top line, and four alternatives, which occurred on a line under the standard. Each item appeared on a separate card in either printed form or in cursive script. The first ten items on each form involved single-letter matching; half of the remaining items on each form were composed of two-letter strings, and the other half, three-letter strings. Children were told to find the alternative which was like the standard. Each item was scored as either correct or incorrect.

Rhyming. The rhyming test consisted of three rhyming tasks, with two parallel versions of each task. In Part 1, the child was shown,

Table 1
Distribution of Subjects by Grade, Class, and Sex

		Fall								Spring							
		Kindergarten				First Grade				Kindergarten				First Grade[a]			
		A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
Form A	M	7	5	8	5	5	5	5	5	6	5	8	5	2	5	5	5
	F	9	10	9	6	4	5	5	5	9	10	7	5	2	5	5	4
		16	15	17	11	9	10	10	10	15	15	15	10	4	10	10	9
	Total A				59				39				55				33
Form B	M	6	4	8	6	5	5	5	5	8	4	8	7	3	5	5	5
	F	7	8	6	4	6	5	5	5	8	9	7	5	3	5	5	5
		13	12	14	10	11	10	10	10	16	13	15	12	6	10	10	10
	Total B				49				41				56				36
	Grand Total				108				80				111				69

[a]The figures shown here represent the students who took reading tests in the spring; they are distributed, however, according to their classification for the fall.

one at a time, three pairs of pictures for which the names of each pair rhymed. The pictures were named and the child told that the words ended in the same way. The six pictures were then arranged randomly in two rows and the child was asked to find each pair which ended the same. Items were scored as correct or incorrect.

In Part 2, the child was shown four pictures, a sample and three alternates, and told the name of each. He then was asked to find the alternate which ended the same as the sample. Six such items were presented, and each was scored as correct or incorrect. In Part 3, the child was shown six pictures, one at a time. For each, he was to give the name and then a word which ended the same as the name of the picture. The child's response was recorded, and later scored as correct (real word rhyme), nonsense (nonsense word rhyme), incorrect, or no response. As a warm-up for this task, the child was given three pictures to name; after each name was said, the experimenter gave a rhyme for the word, and explained that the name and the rhyme ended in the same way.

Results

Test means, standard deviations, and reliabilities (Hoyt r) are shown in Table 2 for the fall testing session, and in Table 3 for the spring testing session. A two-tailed t test, performed on each set of parallel test forms for the fall test session, showed no significant differences between forms. However, due both to the differences in score distributions between most of the parallel forms, and the relatively low reliability of the picture-vocabulary and letter-matching tests, scores on the alternate forms were not combined for subsequent analyses. The first-grade mastery patterns for all tests except word memory span, using 85% correct as mastery, are shown in Table 4. (Since few tests were mastered by the kindergartners, no mastery patterns are shown for that level.) Results for each test are presented below, followed by the results of a multiple regression analysis on first-grade reading scores.

Table 2
Summary of the Fall Testing Results

Test	Grade	Form[a]	N	Mean Number Correct	S.D.	Hoyt r	S.E.
Pix Vocab. (16 items)	K	A	57	10.68	2.97	.74	1.46
		B	51	9.98	3.13	.79	1.39
	1	A	39	12.15	2.12	.61	1.29
		B	41	13.05	2.63	.78	1.19
Alpha Prod. (22 items)	K	--	108	5.19	3.69	.85	1.42
	1	--	80	10.06	6.00	.95	1.35
Alpha Rec. (22 items)	K	--	108	1.97	4.37	.95	.92
	1	--	80	6.20	8.18	.98	1.19
Letter Match (20 items)	K	A	62	15.80	2.77	.58	1.53
		B	46	14.76	3.62	.79	1.61
	1	A	40	18.15	1.89	.59	1.18
		B	40	17.65	2.14	.63	1.28
Rhyming (15 items)	K	A	76	8.79	3.70	.83	1.49
		B	32	8.16	4.83	.91	1.36
	1	A	49	11.71	2.84	.80	1.22
		B	31	11.87	2.58	.79	1.14
Memory Span (Max. = 12)	K	A	61	7.64	1.14	--	---
		B	47	7.19	1.10	--	---
	1	A	39	8.21	1.30	--	---
		B	41	7.90	1.22	--	---

[a]No difference between forms for a test is significant by two-tailed t test.

[1]Because of the nature of this test, which ascertains an upper bound on an ability, none of the quantitative reliability formulae can be applied to it.

Table 3
Summary of the Spring Testing Results (Kindergarten)

Test	Form[a]	N	Mean Number Correct	S.D.	Hoyt r	S.E.
Pix Vocab. (16 items)	A	51	12.65	2.14	.62	1.28
	B	60	12.35	2.89	.77	1.33
Alpha Prod. (22 items)	--	111	6.44	4.04	.87	1.40
Alpha Rec. (22 items)	--	111	5.03	6.08	.95	1.33
Letter Match (20 items)	A	49	16.84	2.44	.66	1.40
	B	62	16.10	2.58	.63	1.54
Rhyming (15 items)	A	49	9.78	3.39	.85	1.26
	B	62	10.05	3.19	.83	1.25
Memory Span[1] (Max. = 12)	A	51	7.90	1.24	--	---
	B	57	8.09	1.39	--	---

[a]No difference between forms for a test is significant by two-tailed t test.

[1]Because of the nature of this test, which ascertains an upper bound on an ability, none of the quantitative reliability formulae can be applied to it.

Tests

Picture vocabulary. Since fewer than 5% of the responses on this test were related, scores for related and incorrect were collapsed into a single incorrect category. Total correct for the various tests and grade levels (Tables 2 and 3) showed that the test was slightly less difficult than desired for a predictive test. This effect resulted from seven items in Form A (1, 2, 3, 4, 5, 7, 15) and four items in Form B (1, 2, 3, 7) which were answered correctly by almost everyone. These items, in turn, also contributed heavily to the relatively low reliabilities of the tests (Hoyt r for Form A was .61 in first grade; Form B, .78 in first grade). Although the two forms were not significantly different at either grade level, the correlations between the forms and the Ortar Reading Test are quite different: .740 for Form A, but .529 for Form B.

Word memory span. For each half of the test (random, related) the score assigned was one less than the length of the first string which the subject failed to repeat correctly on either the first or second attempt. Contrary to expectations, the related items were not significantly easier than the random items. This test required an excessive amount of time to administer, yet showed the least amount of variation of any of the tests across grade levels and time periods. These factors, plus the low correlation between the two parts of the test, also indicate that the test itself may be unreliable.

Table 4
Grade 1 Mastery Patterns

Number of Tests Mastered:	M	F	Total
0	6	5	11
1	6	9	15
2	14	13	27
3	9	8	17
4	3	4	7
5	2	1	3
	40	40	80
Total Subjects Mastering Each Test:			
Vocabulary	15	17	32
Letter Matching	29	32	61
Alphabet Production	7	5	12
Alphabet Recognition	7	7	14
Rhyming	25	19	44
Two-Test Mastery:			
Vocabulary & Matching	3	7	10
Vocabulary & Rhyming	2	0	2
Matching & Alphabet Production	1	0	1
Matching & Rhyming	8	6	14

Table 5
Alphabet Recognition and Production

Recognition						Letter	Production					
K Fall		K Spring		1 Fall			K Fall		K Spring		1 Fall	
N	%	N	%	N	%		N	%	N	%	N	%
41	38	80	73	33	41	א	81	75	106	96	75	94
14	13	50	45	22	28	ב	76	70	106	96	73	91
11	10	34	31	27	34	ג	72	67	100	90	69	86
6	6	23	21	23	29	ד	58	54	87	78	68	85
10	9	23	21	31	39	ה	44	41	76	68	64	80
7	6	17	15	19	24	ו	42	39	82	74	64	80
9	8	23	21	24	30	ז	40	37	68	61	59	74
5	5	17	15	17	21	ח	42	40	68	61	59	74
7	6	18	16	23	29	ט	14	13	35	32	47	59
14	13	53	48	31	39	י	35	32	54	49	45	56
6	6	9	8	18	23	כ	8	7	22	20	20	25
9	8	19	17	24	30	ל	9	8	16	14	23	29
12	11	19	17	23	29	מ	3	3	12	11	18	23
6	6	17	15	21	26	נ	2	2	16	14	15	19
3	3	18	16	21	26	ס	3	3	6	5	15	19
9	8	17	15	24	30	ע	5	5	7	6	12	15
6	6	12	11	16	20	פ	1	1	5	5	10	13
7	6	20	18	18	23	צ	1	1	8	7	13	16
3	3	15	14	18	23	ק	3	3	8	7	13	16
9	8	22	20	22	28	ר	2	2	13	12	13	16
11	10	40	36	23	29	ש	9	8	17	15	14	18
8	7	22	20	20	25	ת	5	5	15	14	17	21

Table 6
Rhyming Subtest Scores for the Fall Testing

Subtest	Number of Items	Grade	Form	N	$\bar{X}$	S.D.
Matching	3	K	A	76	2.08	1.22
		K	B	32	2.12	1.26
		1	A	49	2.84	0.51
		1	B	31	2.87	0.43
Multiple Choice	6	K	A	76	4.35	1.81
		K	B	32	3.97	2.42
		1	A	49	5.43	0.98
		1	B	31	5.64	0.80
Production (Real & Nonsense)	6	K	A	76	2.36	1.94
		K	B	32	2.06	1.95
		1	A	49	3.45	1.94
		1	B	31	3.35	1.92
Production (Real Words Only)	6	K	A	76	1.78	1.54
		K	B	32	1.84	1.82
		1	A	49	3.18	1.83
		1	B	31	3.19	1.97

Alphabet tests. The scores on both alphabet tests were, in comparison to these same skills in the United States, surprisingly low at both grade levels and at both testing periods. Scores on each letter for the fall and spring tests in kindergarten and for the fall test in first grade are shown in Table 5. The relative percentages correct for production show the effects of incomplete memorization of the alphabet in its proper sequence. The rapid decline in percentage correct after the tenth letter probably results from the use of the first ten letter names to designate grade levels in school. (Grade 11 is referred to by a compound of the names of 10 and 1; Grade 12, by a compound of the names for 10 and 2.) Children with older siblings would hear these names frequently. The lack of a similar trend in alphabet recognition indicates the lack of a close relationship between specific letters recognized and the names which can be produced. However, the correlation between total scores for these two skills is extremely high at the first-grade level (.703). This may have resulted, however, from the reading instruction which first graders received before these tests were given.

Of the two tests, letter recognition showed the highest correlation with the Ortar Reading Test and also with the other basic skills tests.

Letter matching. A two-way analysis of variance, length (one vs. two or more) by letter form (print vs. cursive) showed (for Form A, fall testing) a significant main effect for length (F (1, 247) = 114.5, $p < .01$), but not for letter form. Single-letter strings were clearly easier than two- or three-letter strings for both kindergartners and first graders. A t test failed to show a significant mean difference between the printed two-letter strings and the printed three-letter strings.

Item analyses failed to show any consistent factor in the more difficult items; however, the relatively low reliabilities of the two forms clearly derive from the lack of difficulty of the one-letter strings.

Rhyming. Results of the fall testing for the different components of the rhyming test are shown in Table 6. The matching and multiple-choice tasks were too easy for first graders, while the production task, counting the real word responses as correct, was too difficult for kindergartners. Correlations of the various components with first-grade reading ability showed that the multiple choice task consistently had the highest correlation, exceeding the total rhyming score for several reading test components. This is not altogether unexpected, however, in that the matching task confounded paired-associate learning with rhyming, while the production task depended in part upon verbal fluency. (The relatively low correlation of rhyme production and picture vocabulary, therefore, is quite surprising.)

Table 7
Reading Test Results
Grade 1
(N = 69)

Test	Number of Items	$\bar{X}$	S.D.
Ortar	44	25.23	11.47
Kidron			
Syllables	325	266.93	84.61
Words in Isolation	36	33.03	8.52
Sentences	5	4.22	1.40
Words in Sentences	36	32.22	9.66

Correlations with reading. To test the ability of the various tests to predict reading ability at the end of first grade, two different reading tests were administered to each first-grade subject at the end of the school year. One test (Ortar) consisted of 44 multiple-choice questions which tested comprehension of single words, phrases, sentences, and short paragraphs. Each of the first 12 test items consisted of a picture and four alternative words or phrases, from which the child was to select the one which best described the picture. Each of the next 12 items consisted of a picture plus a sentence which described what the child was to draw in the picture. (For 11 of the 12 items the instruction was to draw a circle around one of the picture components; for the 12th item the instruction was to draw a letter in a particular square.) The remaining 20 items were multiple-choice questions on the paragraphs which preceded them. The other reading test (Kidron) consisted of the following subtests:

1. Syllables: 325 printed syllables which the child was to pronounce one by one. Each item was scored as correct or incorrect.

2. Words in isolation: 36 printed words which the child was to pronounce one by one. Each word was scored as correct or incorrect.

3. Sentences: Five sentences which were to be read aloud. A sentence was scored as correct if read aloud exactly as printed and as incorrect if one or more mistakes were made.

4. Words in sentences: Each of the 36 words which occurred in the sentences (subtest 3 above) was scored correct or incorrect according to how it was read aloud.

The means and standard deviations for these tests are shown in Table 7. Score distributions for the Ortar test (raw scores) and for the words in isolation section of the Kidron test are shown in Figures 1 and 2, respectively.

From Table 7 and Figure 2, it can be seen that the Kidron test scores had a skewed distribution with a pronounced ceiling effect. Consequently, only the Ortar scores were used in the multiple regression analysis.

On the basis of score distributions, four basic skills subtests were selected for inclusion in a multiple regression analysis: picture vocabulary, letter matching, letter naming, and the selection section of the rhyming test. Correlations among these tests are shown in Tables 8 and 9.[2]

[2]The high correlation (.740) between Form B picture vocabulary and the Ortar Reading Test appears to result from the inclusion of picture identification in almost half of the test items on the Ortar test.

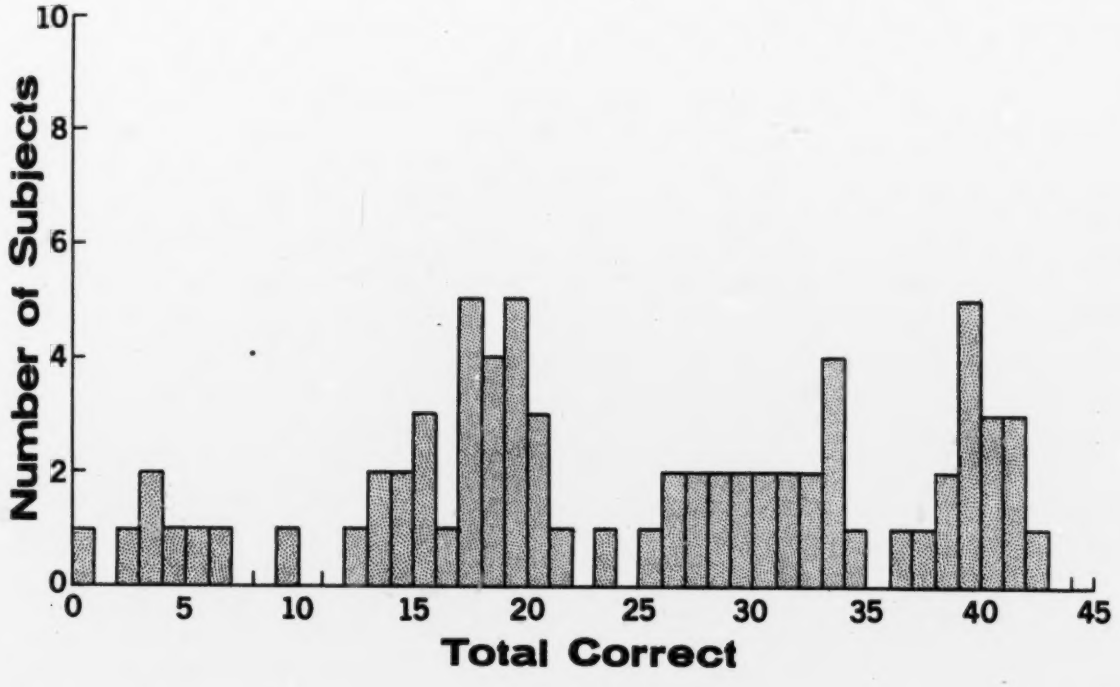

Fig. 1. Distribution of scores on the Ortar test.

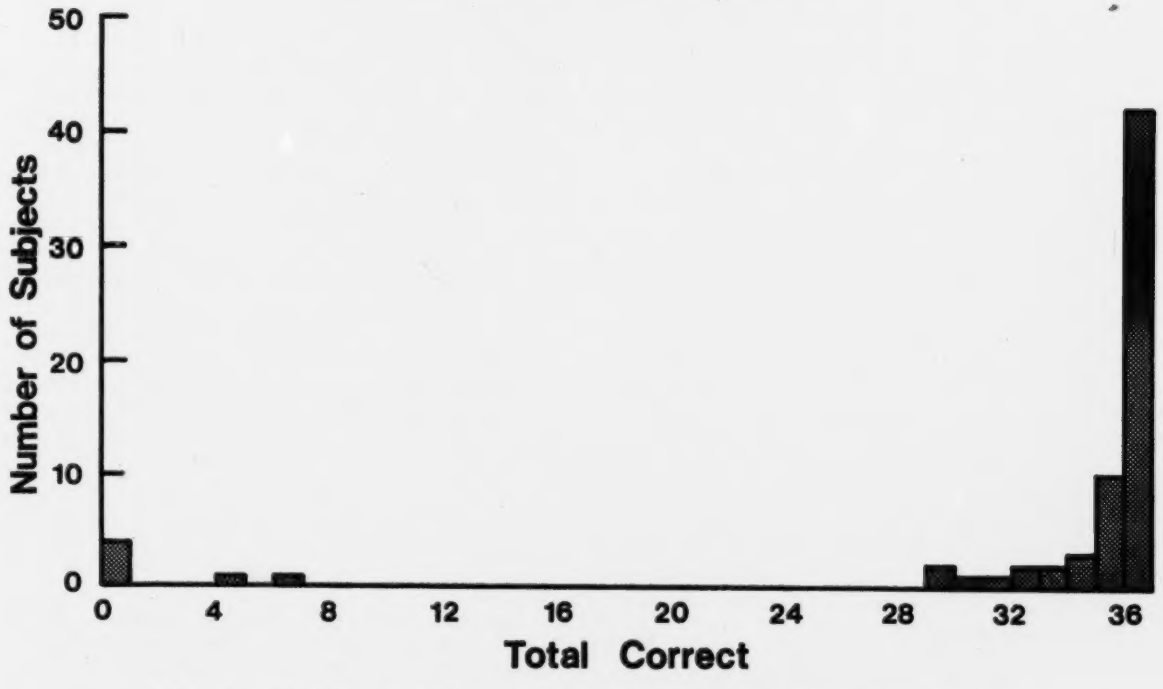

Fig. 2. Distribution of scores on the Kidron test—words in isolation.

The highest multiple correlation for Form A, using the Ortar reading score as the dependent variable, was .758, which resulted from combining rhyming, letter matching and letter naming, and picture vocabulary. However, without picture vocabulary in this group, the multiple correlation drops only to .756. For Form B, the multiple correlation of rhyming, letter matching, and letter naming with Ortar reading is .763. However, the addition of picture vocabulary to this group raises the multiple correlation to .839.

Table 8
Correlations Among Form A Subtests and Ortar Reading Scores

	Grade 1 (N = 33)				
	1	2	3	4	5
1. Ortar Reading	1.000				
2. Picture Vocabulary	.450**	1.000			
3. Letter Matching	.529**	.505**	1.000		
4. Letter Naming	.583**	.338	.281	1.000	
5. Rhyming	.620**	.645**	.463**	.400*	1.000

*$p < .05$
**$p < .01$

Table 9
Correlations Among Form B Subtests and Ortar Reading Scores

	Grade 1 (N = 30)				
	1	2	3	4	5
1. Ortar Reading	1.000				
2. Picture Vocabulary	.740**	1.000			
3. Letter Matching	.615**	.688**	1.000		
4. Letter Naming	.602**	.343*	.389*	1.000	
5. Rhyming	.532**	.551**	.574**	.219	1.000

*$p < .05$
**$p < .01$

Discussion

The results of these tests were encouraging for the development of a predictive/diagnostic test of reading ability, yet revealed a variety of problems which remain to be solved. One of the more important of these problems concerns the methodology followed during this year, particularly in respect to the development of parallel forms. Our original motivation for using parallel forms stemmed from a concern for measuring test reliability; however, since the subject population required for developing parallel forms is twice what is required for developing a single form, the cost in personnel and expenditures is also twice (or nearly twice) as high, and this at the present time is beyond our financial abilities. In addition, parallel forms, especially in the development stages, do not measure reliability as well as a test-retest procedure. Therefore, one major change in methodology for the coming year is to concentrate on developing a single form of each test, using from one and one-half to two times as many items per test as we anticipate for the final version. Then, through item analyses, we will select the most discriminating items.

A second change in methodology is to concentrate on test items which discriminate sharply at the lower end of the ability scale for each test. This will allow us to identify most accurately those children who have deficits in skills and therefore require special attention. The tests, therefore, should be relatively easy for the average child entering first grade and slightly difficult for the average kindergarten child toward the end of the kindergarten year.

A third change is to concentrate on tests for skills which are related to learning to read and which could be taught during kindergarten or at the beginning of first grade. For these reasons, memory span, alphabet production, and letter naming will be dropped, the first because generally it could not be taught, and the latter two because they do not have a high correlation with reading and are not desired in the initial teaching of reading in Israel.

Picture vocabulary will be retained as one measure of language background as will rhyming, which appears to measure both language background and ability to deal with sounds as abstractions—an ability which is important for learning to read. The multiple-choice component of the rhyming test will be retained, as it was the best direct measure of rhyming ability.

Letter matching will be retained, also, but only for two-, three-, and possibly four-letter strings. Studies will be carried out in the fall on different formats for the test, particularly in regard to scanning direction, and specific errors will be recorded to determine both position biases and tendencies to make orientation and order reversals.

In addition, several new tests may be added, depending upon the results of a new pilot testing. One is a test for sound matching, developed last spring, and the other is a test for knowledge of prepositions, which is being developed now. In parallel with each test we will also begin development of instructional procedures and materials in cooperation with the kindergarten teachers.

Finally, the subject population will be extended to 12 kindergartens: four high SES, four middle SES, and four low SES. This will allow us to assess accurately the skills possessed by children who become successful readers at the kindergarten level and therefore to establish norms which the other children should meet before they begin reading instruction.

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II
A Comparison of Two Sound-Matching Tests for Hebrew-Speaking Children

R. Venezky and Y. Shiloah

Introduction

Matching sounds in aurally-perceived words is one of several skills which children need for learning to read. This ability is used primarily in letter-sound learning, as, for example, in forming a generalization from the pronunciations of words like ship, shut, and show that initial sh is pronounced /š/. In the initial stages of forming such a generalization, the child sees the printed form of a word and hears along with it its pronunciation, the latter coming either from an external source (e.g., a teacher) or from himself (e.g., in seeing a picture of a ship with the word ship printed underneath). To achieve the appropriate generalization, the child must segment the aural word into basic sound units, associate each of these with a spelling pattern, and finally, after seeing a variety of words in which an initial sh is pronounced /š/, identify the various pronunciations of sh as the same and thereby form the generalization. Without the ability to match component sound units which are perceived within a continuous acoustical stream, the last step in this process could not be made.

How sound-matching ability is acquired has not been explored extensively. McNeill and Stone (1965) have shown that kindergarten-aged children can with some difficulty acquire the ability to make a dichotomous classification based upon the initial sound in a word, and Chapman (1971) has shown that sound-matching ability in kindergarten is a good predictor of reading success at the end of Grade 1. Both of these studies, however, were done in the United States with English-speaking children. To explore the relationship in Israel between sound matching and reading, tests must first be developed to evaluate this ability with Hebrew-speaking children. Then, if a high correlation with reading is found, instructional procedures can be explored. The present study is concerned with the development of tests for evaluating the sound-matching abilities of Hebrew-speaking Israeli children. Two different tests, a multiple-choice test and a yes/no test, both using pictures as props, were compared. Both tests were based on similar tests developed at the University of Wisconsin for the Prereading Skills Program (Venezky, Kamm, Leslie, Pittelman, & Seegal, 1971).

Method

Procedure

In both sound-matching tasks the child was to determine whether or not a particular word contained a target sound. The sounds which were used had been taught previously to each child as responses to particular pictures. The picture-sound pairs were reviewed immediately before the sound-matching test, and the pictures were then used to indicate which sound the child was to find in the test words. For both versions, test items were blocked by sound; all of the items for /š/ occurred first, then the items for /a/, and finally the items for /s/. In Version I (multiple choice) the child indicated on each trial which of three pictures contained the target sound; in Version II (yes/no) the child said whether or not a single picture (i.e., the name of the picture) contained the target sound. Two practice items preceded Version I and four preceded Version II.[1] For both versions the pictures for the target sounds were outline drawings mounted

[1]The practice trials were equated for total number of correct items (two).

Table 10

Stimulus Items for Sound-Matching Test
(Test words are underlined)

		Selection Form	Yes/No Form			
Practice:	a.	שעון, כלב, פרח	a.	שעון	c.	פטיש
	b.	כסא, מזלג, פטיש	b.	כלב	d.	פרח
Test Sound /š/:	1.	ילדה, שלחן, בלון	1.	שלחן	5.	שפן
	2.	בית, נחש, דגל	2.	בלון	6.	מזלג
	3.	כד, וילון, שפן	3.	כסא	7.	ילדה
	4.	אש, חוף, פיל	4.	נחש	8.	אש
Test Sound /a/:	5.	אוטו, נר, דג	9.	נר	13.	קוף
	6.	קוף, יד, רגל	10.	רגל	14.	כף
	7.	עץ, כף, ילד	11.	דג	15.	צב
	8.	צב, דלי, לימון	12.	יד	16.	אוטו
Test Sound /s/:	9.	ארון, כוס, גג	17.	כוס	21.	גג
	10.	נעל, סיר, עז	18.	סיר	22.	נעל
	11.	ספל, עלה, פרח	19.	עז	23.	ארון
	12.	מטוס, חתול, פרפר	20.	ספל	24.	מטוס

on white card stock. A picture for a target sound was shown briefly before the block of trials in which its sound occurred. Positive feedback was given after each trial (in each version), regardless of the response.

Stimuli

For Version I (multiple choice), four different trials were run for each sound. Within the groups of four, for each of the two consonants /š/ and /s/, the target sound occurred twice in initial position and twice in final position. For /a/, only medial position was used. The position of each set of pictures within a block was randomly assigned. The three pictures for each trial were outline drawings, mounted in a horizontal row on a single flashcard. The response items, including those for two practice trials, are listed in Table 10.

For Version II, the 12 correct items from Version I plus 12 of the 24 alternates were shown, each mounted separately on white card stock. These also are indicated in Table 10.

Subjects

The Ss were 54 kindergarten children, 24 boys and 30 girls, with a mean age of 5 years, 10 months. Eleven boys and 15 girls were randomly assigned to Version I and 13 boys and 15 girls to Version II.

Results

The mean percentages correct on each sound and each test version are shown in Table 11.[2] A 2 by 3 (Condition by Sounds) analysis of variance, with repeated measures on the last factor, was done on the proportion scores. The results showed a significant main effect for sound ($F = 14.1$, $df = 1/52$,[3] $p < .01$), but not for version or for the interaction of version with sound.

A rank ordering of words by error rates (Table 12) shows no obvious differences between initial and final position for the two consonants, although the total errors on initial position (49) were slightly higher than those for final position (41). Since position and sound are not independent in this study, no valid conclusions can be drawn about difficulty of matching by position. For the yes/no version, the mean correct on items which contained a target sound was 65.7%, and the mean correct for the items which did not contain a target sound was 76.0%.

Table 11
Mean Percentages Correct

	[š]	[a]	[s]	Total
Version I	78.6	68.2	83.5	76.8
Version II	78.1	59.0	75.4	70.8
Combined	78.5	64.8	79.5	74.4

Table 12
Rank Ordering of Correct Items by Total Errors
(N = 54)

Rank	Word	Sound	Total Errors
1	יד	[a]	31
2	כף	[a]	24
3	דג	[a]	23
4	צב	[a]	19
5	שלחן	[š]	18
6	אש	[š]	14
7	ספל	[s]	13
8	כוס	[s]	11
9	מטוס	[s]	11
10	סיר	[s]	10
11	שפן	[š]	8
12	נחש	[š]	5

Discussion

The overall proportions correct are sufficiently high to indicate that Israeli kindergartners in general can perform above chance on these sound-matching tasks: 21 of the 54 children per-

[2]Scores on the yes/no version were obtained by weighting all 24 items equally.

[3]Reported as 1 and 52 with Geisser-Greenhouse correction for degrees of freedom.

formed at better than 80% correct and 14 of the 54 were above 90%. The significant effect for sound is due to the relatively low scores for the vowel [a], but since this vowel occurred in medial position only, the relative difficulties of medial position, vowels as compared to consonants, and the specific vowel /a/ cannot be determined. Additional testing is required for separating these factors. The score distributions do not indicate that either test has an advantage over the other in giving a smooth distribution of scores. However, the number of subjects is not sufficiently high for estimating population distribution curves. Chapman (1971) reports a distribution which approaches a normal curve for a similar multiple-choice sound-matching test with four choices, given to middle and lower-middle class children in the United States in the middle (February) of their kindergarten year. (For Chapman's test 138 children were sampled.)

Since the two test versions produced similar overall scores and similar patterns of errors and since, furthermore, there was no Sound by Version interaction, the tests were judged to be equal in difficulty. The selection version, because it is a more convenient test to administer and has a lower guessing rate than the yes/no test, is judged to be the better test.

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III
A Comparison of Two Syllable-Blending Tests for Hebrew-Speaking Children

R. Venezky and Y. Shiloah

Introduction

In pronouncing words aloud from their spellings, a competent reader assigns sounds to letters or letter sequences and then blends these sounds into a word. Blending ability has been found to be lacking in many children who have difficulties in learning to read (Desberg, 1969). Tests for blending ability have been developed for English speakers (Balmuth, 1966; Chall, Roswell, & Blumenthal, 1963; Coleman, 1970), but so far no similar tests for Hebrew speakers have been reported and therefore the relationship between blending ability and reading in Israel has not been explored.

The present study, which is part of a larger investigation of the prereading skills of Israeli children, was undertaken to design and evaluate blending tests for Hebrew-speaking children. In the experiment reported here, two tests for syllable blending (as opposed to phoneme blending) were designed and compared. The decision to begin with syllable blending was based on studies reported by Venezky (in press) which show phoneme blending to be quite difficult for prereading children, but syllable blending to be fairly easy. Once a reliable test paradigm for syllable blending is developed, it will be extended to phoneme blending.

Method

Procedure

Two syllable-blending procedures were compared. In both, children were tested individually by an experimenter who introduced the task by saying that she would say a word in a funny way and the child was to guess what the word was. Then, for each test item, a sequence of two syllables was presented orally with a one-second pause between syllables. The child responded either by pointing to one of three pictures placed before him (Condition 1), or by saying a word (Condition 2). In Condition 1 the experimenter named the pictures immediately after pronouncing the two syllables. The child responded by pointing to a picture and also naming it. E always responded with positive feedback ("good," "fine") and went on to the next item. In Condition 2 the experimenter asked "What is. . ." followed by the two syllables with a one-second pause between them. After S responded, positive feedback was given as in Condition 1.

Stimuli

Stimuli and response distracters were all common, two-syllable words, selected on the basis of a published frequency count of the vocabulary of school children (Balgur, 1968) and a questionnaire on kindergartners' vocabularies, filled out by kindergarten teachers in the summer of 1970. In Condition 1, 12 test cards contained three pictures each, one of the correct word and two of distracters. For six of the 12 cards, the distracters contained no syllables in common with the correct item, but for each of the remaining six, one distracter contained an identical first syllable and one contained an identical final syllable. Pictures were outline drawings, mounted on white card stock, with the position of the correct item randomly selected. E shuffled the deck each time she began testing a new S, and gave five practice items before introducing the 12 test items. Stimulus items are shown in Table 13.

Table 13
Stimulus Items for Syllable-Blending Test
(Standard words are underlined)

	Condition 1	Condition 2
Practice:		
a.	ארון, שלחן, בקבוק	שלחן
b.	ספר, כפית, שמש	שמש
c.	פרה, סירה, פרפר	פרה
d.	סכין, סנדל, שעון	סנדל
e.	אוטו, נחש, פטיש	פטיש
Items without common syllables:		
1.	נוצה, בבה, כריח	בבה
2.	פמוט, ספל, נעל	פמוט
3.	ילד, כלב, חלצה	חלצה
4.	ספסל, לימון, עלה	ספסל
5.	רגל, שפן, כשפך	שפן
6.	תירס, צפורן, פרח	פרח
Items with common syllables:		
7.	חתול, חלון, בלון	חלון
8.	דגל, רגל, דלת	דגל
9.	כסא, כנור, סנגר	כנור
10.	ברוז, זית, בית	בית
11.	מטוס, מזלג, כוס	מטוס
12.	ילדה, סיכה, שמלה	שמלה

Subjects

All Ss were selected from Israeli kindergartens in lower and lower-middle class neighborhoods. For Condition 1, 13 boys and 15 girls (mean age 5 years, 10 months) were tested; for Condition 2, 14 boys and 12 girls (mean age 5 years, 10 months) served as Ss.

Results

The percentage correct for Condition 1 was 100 and for Condition 2, 95.5 ($\bar{X} = 11.46$). The range of scores on Condition 2 was from 8 to 12, with 19 of the Ss receiving perfect scores. Mean correct for girls on Condition 2 was 11.5; for boys, 11.75. Two-thirds of the errors on Condition 2 were on the items in which the distracters contained no syllables in common with the correct item. However, because of the low number of errors (15 out of 312 choices), this distribution probably has little significance. Because of the extremely high number of correct responses, no tests for significance of mean differences were performed.

Discussion

Both tests demonstrated that Israeli kindergartners have little difficulty in blending syllables. Hence, both test paradigms are adequate for assaying this skill. The oral response task, although producing more errors than the picture response task, is preferred for further work because of its simplicity in administration. The extension of this paradigm to phoneme blending, however, will probably require modification in the test instructions and possible the method itself, judging from similar studies in the United States (Chapman, 1971; Venezky, in press). This is due to a fundamental difference between syllable blending and phoneme blending; syllable blending can be done by rapid repetition of the stimuli in exactly the same form as they are perceived. But this strategy will not work for phoneme blending because sounds which do not precede a syllable or word juncture are dramatically altered by the sounds which follow them. In this situation, each sound must be articulated with anticipation, and therefore appropriate modification, for the sound which follows. In general, adjoining the separate sounds in time will not produce anything close to a word. Hence, ability in syllable blending may not correlate at a high level with ability in phoneme blending.

Finally, it should be observed that tests such as those described in this report are not identical to the blending task encountered in reading. For testing blending of nonreaders, stimuli to be blended are presented orally, thus introducing a higher memory load than is present in reading where the stimuli are generated by the reader from continually observable visual patterns. So far, the effects of this added memory load are not known. Because the training required for testing blending of nonreaders with visually-prompted stimuli is too great to be included in a practical test, future research will probably continue to rely upon orally-presented stimuli.

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IV
The Learning of Picture-Sound Associations by Israeli Kindergartners

R. Venezky and Y. Shiloah

Introduction

The methods now in use for teaching letter-sound correspondences vary widely within most countries, but nevertheless center on four basic paradigms: (a) direct pairing, (b) letter-name mediators, (c) common noun mediators, and (d) logical symbol-sound relationships. In Method a, a letter is presented along with its associated sound, usually with an explanation like "When we see the letter x, we say /y/." This method is probably the least successful of the four, and is not widely used today. Method b—letter-name mediators—uses the letter names to mediate between the letters and the sounds. In some reading programs used in the United States, for example, children see the letter b, are taught its name, bee, and then are told that its sound is /b/. According to Durrell (1958, p. 5), "Since most letter names contain the sounds of the letters, the ability to name letters should aid in establishing relationships between the phonemes of the spoken word and the printed form of the word." However, for English the letter names are poor mediators for letter sounds, in that three do not contain the sound for which they supposedly mediate (h, w, y), seven do not contain the sound which is typically introduced first for that letter in reading programs (a, c, e, g, i, o, u), and of the remaining 16, seven contain the sound they mediate for in final position, while nine contain the sound in initial position (Venezky, 1971). For Hebrew, the letter names are consistently better mediators, yet there is some indication that letter-name knowledge is less than helpful for learning to read.

In Method c—common noun mediators—a single word which contains the letter sound (usually a common noun) is paired with the letter, such as (for English) "A is for apple." The child presumably learns to segment the appropriate sound from the word, a task which is quite difficult for young children (Bruce, 1964; Calfee, Chapman, & Venezky, 1970).

In Method d—logical symbol-sound relationships—children are taught through a short narrative that a letter makes a certain sound. This method, which appears to be used successfully in both Israel and the United States, provides a memory structure for linking the sound to the symbol, yet still teaches the sound response directly. Objections, especially by linguists (Bloomfield, 1942), that children cannot handle individual speech sounds have been shown experimentally to be unfounded (Marsh & Sherman, 1970; Venezky, Chapman, Seegal, Kamm, & Leslie, 1971).[1] This method, furthermore, was found to be highly successful in the United States for teaching picture-sound pairs to kindergarten children and is used now to facilitate the teaching of sound matching and sound blending (Venezky, et al., 1971). Based on this preliminary evidence, a study was designed to test several different proce-

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[1] "The authors of these methods [phonic methods] tell us to show the child a letter, say t, and to make him react by uttering the (t) sound. This sound is to be uttered either all by itself, or else with an obscure vowel sound after it. Now, English-speaking people, children or adults, are not accustomed to make that kind of noise. The sound (t) does not occur alone in English utterance; neither does the sound (t) followed by an obscure vowel sound. If we insist on making the child perform unaccustomed feats with his vocal organs, we are bound to confuse his response to the printed signs" (Bloomfield, 1942, p. 128).

dures for teaching picture-sound pairs through logical relationships to Israeli kindergarten children, varying (a) the method used to introduce the sounds, and (b) the teacher-pupil ratio for instruction.

Method

Subjects

The Ss were 108 kindergartners (boys and girls) drawn from four middle and low class communities in Israel. The average age of all Ss was 5 years, 8 months.

Stimulus Materials

Stimuli consisted of 12 white cards, 5 1/2" x 7 3/4", with line drawings—one on each card—of the following: 1. a train; 2. a cow; 3. a bee; 4. a tractor; 5. a goat; 6. a snake; 7. a woman standing on a chair looking at a mouse on the floor; 8. a girl holding her index finger to her lips as if requesting silence; 9. a cat; 10. a hand on which a finger has been bruised by a hammer which is visible; 11. a duck; 12. a boy with an expression on his face indicating surprise. (See Appendix A for copies of the pictures.) The responses to be learned to the stimuli were chosen to have as plausible a connection as possible to their stimuli. The responses in IPA (presented in order corresponding to the stimuli above) were the following: /u/, /m/, /z/, /r/, /e/, /s/, /i/, /š/, /x/, /o/, /g/, /a/.

Procedure

The task required five different sessions, each one on a different day. Sessions 1-4 were on consecutive days; Session 5 occurred 10 days after Session 4. For each of the first three sessions a different list of four stimuli was introduced and the response to each picture was taught. The order of presentation for all groups was: Session 1—train, cow, bee, tractor; Session 2—goat, snake, woman, girl; Session 3—cat, hammer, duck, boy.

In Session 4 all subjects were retrained on the three lists, and in Session 5 all subjects were tested individually for recognition of the appropriate picture, given a sound (Recognition Test), and for production of the appropriate sound, given a picture (Production Test). During the 10 days which intervened between Sessions 4 and 5, no exposure to either the pictures or the sounds was given. Treatments differed according to (a) introduction of the picture-sound stimuli and (b) training procedure. For convenience, the various procedures are divided into two sets of comparisons.

Comparison 1. In the first comparison, children from two kindergartens, representing a middle and a low SES area were randomly assigned to either a paired-associate introduction of the stimuli or to a story introduction; within these groups, children were then assigned randomly to either individual or group training. The total number of subjects for each treatment in this design is shown in Table 14.

Table 14
Distribution of Subjects for Comparison 1

	Kindergarten			
	A (Middle)		B (Low)	
	Indiv.	Groups	Indiv.	Groups
Paired-Associates	4	12	3	7
Story	4	8	4	3
Total	8	20	7	10

For the story introduction, Ss were introduced as a group to the task with a brief narrative read by E, which utilized each of the four stimuli on that day's list. (Copies of the three stories are included as Appendix B.) As each new stimulus was mentioned in the story (e.g., the train), the subject was shown the line drawing for that stimulus, and was told that the stimulus "says X," X being the appropriate response. The stimulus card was placed on a table in front of S. This procedure was followed for each of the four stimuli. When E had reviewed once with each S the appropriate response for each stimulus, the learning trials began.

For the paired-associates introduction, E presented each picture once, stating the name of the object pictured and what the object said.

During each individual training trial (Sessions 1-3), four items were presented one at a time in a random order until S gave correct responses for all stimuli in two consecutive trials (criterion) or until S had attempted 20 trials. E shuffled the items before each trial and turned the cards faceup one at a time. For each card, E asked "What does X say?" while pointing at the item. If S's response

was correct, E said "good" or "correct," and presented the next card. If S gave no response or an incorrect response, E gave the correct response, S repeated the response, and then E presented the next item. At no time was more than one card facing up. The total number of trials to criterion was recorded.

In Session 4, Ss were retrained on each of the three lists according to the procedure described above, until criterion was reached or until 20 trials with each list had been tried. The number correct on the first trial was recorded for each list, as were trials to criterion.

Training for groups was the same as that for individuals, except that the children sat in groups of four or five. Each child received in turn a single trial, with the children who reached criterion skipping further trials, but remaining in the group. When a child gave an incorrect response, E either gave the correct response or asked someone in the group who had already reached criterion to give the response. As in individual training, total trials to criterion were recorded in Sessions 1-3, and total correct on the first trial of each set of four stimuli plus total trials to criterion were recorded in Session 4.

Production and recognition tests. In the production test the 12 stimulus items were shuffled by E to achieve a random order. Each item was then shown to S who was asked what that stimulus "says." No feedback was given by E and the list was used only once, whether or not S's responses were correct. In the recognition test the 12 stimulus items were shuffled by E and placed face up on a table in two rows of six items each. E pronounced each phoneme response and asked S to point to the item which would say the given sound. The order of the tests was randomized across subjects.

Comparison 2. For Comparison 2, the production and recognition scores from the individual and group subjects of Comparison 1 were compared to the same scores for two kindergarten classes ($N = 60$) which were introduced to the stimuli and trained as whole classes by their regular classroom teachers. The kindergarten teachers were given the outline of the narratives used in Comparison 1 (story introduction) and the text of a song for each stimulus set and asked to tell the stories and teach the song to the class in whatever way they preferred. The order of introduction for the stimuli was the same, however, as in Comparison 1. The children were never told that they might later be tested on their knowledge of the sounds.

Each teacher took about 15-20 minutes of the discussion session at the same time each day to present four new stimulus cards by the narrative, to teach a new verse of the song, and to review the verses which had already been taught. She pronounced the response sounds in isolation and asked the class to imitate her precisely, correcting errors whenever she noticed them. A colored paper was placed on the wall prior to each session; then, whenever a new stimulus picture was presented, it was pasted on the paper. After telling the story, the teacher taught the song, working with one line at a time. The class then played various games—one a day (according to the teacher's initiative)—with the different stimulus cards presented on that day. Once a verse had been taught, the colored paper with the four picture stimuli was left on the wall for children to re-examine later and for reviewing the song at the end of the school day.

In Session 1 no training or testing took place beyond that described. In Session 2, after stimuli 5-8 were taught, half of the children in each of the two kindergartens (randomly assigned) were tested individually for short-term recall of the sounds which were taught that day.

Each S was given a maximum of five trials. On the first trial E told S that she wanted to know if S could remember the sounds from the song S had learned in class that day. E then presented the four stimulus cards, one at a time, in the same order they were presented in class and appeared in the song. E asked "Do you remember what X says?" (X being the stimulus item). If S gave the appropriate response E gave positive feedback. If S did not give the appropriate response E repeated the correct phoneme and then asked S to imitate the sound until S said the response correctly. E turned each card face down after it had been shown so that no more than one card was shown at a time.

On Trials 2 through 5 E shuffled the cards before each trial, so that the order of presentation of stimuli was random. A correct response to all four stimuli on two consecutive trials was criterion. Thus the best score one S could receive was 2 and the worst was 5.

In Session 4 all three verses were reviewed by the teacher and her class. The subjects who were tested on Day 2 were then individually tested for recall with the procedure described above for Day 2 except that the maximum number of trials for each set was 20. Each of the sets was presented separately in order corresponding to the order of the verses in the song. In Trials 2 through 20 the order of presentation of stimuli was random.

Table 15
Means for Small Group
and Individual Training

		Class 1		Class 2	
		Indiv.	Groups	Indiv.	Groups
Production[a]	Story	9.75	10.63	7.75	11.67
	P-A	10.75	10.67	5.67	11.14
Recognition	Story	9.50	10.63	9.25	10.33
	P-A	10.75	11.67	8.67	10.57
Total Sessions[b]	Story	20.25	17.88	36.25	13.33
	P-A	19.50	12.08	51.33	22.71
Retraining First trials[c]	Story	8.37	6.50	10.25	6.00
	P-A	8.00	6.75	11.67	10.29
Total Retraining[d]	Story	10.50	11.75	9.00	12.00
	P-A	11.25	11.08	10.33	9.71

[a]Max. = 12
[b]Min. = 6
[c]Max. = 12
[d]Min. = 6

Results

Comparison 1

Three students were absent for part of the training and testing procedure and were dropped from the analysis of results. For the remaining 45, the means for each introduction type (story, paired-associates), training organization (individuals, groups), and school class (two), using five dependent measures,[2] are shown in Table 15. Separate 2 x 2 x 2 unequal-n analyses of variance were run on these data for each dependent measure. The results, shown in Tables 16-20, indicated that there was no significant effect for introductory type for any of the five measures, but that training organization was significant ($p \leq .01$) for production, recognition, and sum of training trials. The class effect was significant at the .01 level for sum of training trials and significant at the .05 level for the remaining three dependent measures. There was only one significant interaction at the .01 level, that of training organization and class, for production. As shown in Table 16, the training organization effect resulted from the superiority of training in small groups over individual training.

Since the stimulus items differed widely in difficulty (see below), no learning effect over time could be evaluated. However, in only about 12% of the trials in Sessions 1-3 did an S fail to reach criterion within 20 trials.[3]

[2]The dependent measures were:

1. Total correct on recognition (max. = 12)
2. Total correct on production (max. = 12)
3. Sum of trials to criterion for the first three sessions (min. = 6, max. = 60)
4. Total correct on the first retraining trial for each three sets of stimuli (max. = 12)
5. Sum of trials to criterion for retraining (min. = 6, max. = 15)

[3]There were 135 trials (45 Ss by 3 trials each).

Table 16
Analysis of Variance for
Production Scores

Source	df	MS	F
Introduction (A)	1	.016	.007
Organization (B)	1	39.94	17.81**
Class (C)	1	15.93	7.10*
A x B	1	0.06	0.003
A x C	1	4.77	2.13
B x C	1	34.03	15.17*
A x B x C	1	1.30	.58
Error	37	2.24	

*$p < .05$
**$p < .01$

Table 17
Analysis of Variance for
Recognition Scores

Source	df	MS	F
Introduction (A)	1	7.59	4.10
Organization (B)	1	16.32	8.62**
Class (C)	1	8.61	4.54*
A x B	1	0.37	0.19
A x C	1	3.01	1.59
B x C	1	0.61	0.32
A x B x C	1	0.60	0.32
Error	37	1.89	

*$p \leq .05$
**$p \leq .01$

Table 18
Analysis of Variance for Sum of
Trials to Criterion, Sessions 1-3

Source	df	MS	F
Introduction (A)	1	9.11	0.05
Organization (B)	1	2053.67	12.11**
Class (C)	1	1419.53	8.37**
A x B	1	137.01	0.81
A x C	1	316.00	2.34
B x C	1	995.37	5.87*
A x B x C	1	0.25	0.00
Error	37	169.65	

*$p \leq .05$
**$p \leq .01$

Table 19
Analysis of Variance for Sum of
Trials to Criterion, Session 4

Source	df	MS	F
Introduction (A)	1	9.60	1.19
Organization (B)	1	43.36	5.36*
Class (C)	1	64.25	7.95**
A x B	1	1.67	0.21
A x C	1	18.90	2.34
B x C	1	4.03	0.50
A x B x C	1	3.88	0.48
Error	37	8.08	

*$p \leq .05$
**$p \leq .01$

Table 20
Analysis of Variance for Total
Correct on First Trials, Session 4

Source	df	MS	F
Introduction (A)	1	0.95	0.41
Organization (B)	1	6.82	2.93
Class (C)	1	11.72	5.03*
A x B	1	11.51	4.94*
A x C	1	1.07	0.46
B x C	1	0.70	0.30
A x B x C	1	2.74	1.18
Error	37	2.33	

*$p \leq .05$

Comparison 2

Since no significant difference was found for either production or recognition scores (t test) between the subjects who were tested after Session 2 and those who were not, the two groups were combined for subsequent analysis. The means for production and recognition for individuals, small groups, and whole class are shown in Table 21. A one-way unequal-n analysis of variance of these data showed a significant effect at the .01 level for production (F (2/102) = 5.36) and at the .05 level (F (2/102) = 4.27) for recognition. A post-hoc Scheffé test showed (for production) significant differences between individuals and small groups, and between individuals and whole class, but not between small groups and whole class. For recognition, only the difference between individuals and whole class was significant.

Table 21
Mean Correct for Production and Recognition, Comparison 2

	N	$\bar{X}$ Production	$\bar{X}$ Recognition
Individuals	15	8.67	9.60
Groups	30	10.63	11.00
Classes	60	10.43	10.77

Differences Among Stimuli

The errors on each stimulus item during production testing, summed across Ss, are shown in Table 22. A Cochran Q Test on these data showed a significant deviation from a random error distribution (Q = 119.74; df = 11; $p < .001$). Because of these differences among the stimuli, learning effects across training sessions cannot be evaluated. The two items which received the most errors both involved vowel responses (/e/ and /o/); however, the quality of the pictures and the plausibility of the picture-sound association appeared to have been the major determinants of difficulty.

Table 22
Production Errors on Each Stimulus
(N = 105)

Sound	Errors
/z/	13
/o/	39
/š/	1
/m/	9
/a/	16
/x/	24
/u/	21
/s/	11
/e/	40
/g/	19
/i/	12
/r/	7

Discussion

There are two striking results which emerge from this study. The first is that children at the kindergarten level can learn with relative ease to give individual speech sounds as responses to visual stimuli and can retain these associations for at least ten days without intervening practice. (The average loss for the ten-day period was less than two associations out of 12.) This result is contrary to popular notions held by many linguists and educators that children have extreme difficulties in memorizing and producing single speech sounds, and bears directly on the teaching of reading in that it shows that the manipulation of sounds in isolation is not difficult per se for young children.

The second and equally striking result was that instruction in small groups and in a whole-class setting was superior to individual instruction. While this result cannot be extended automatically from the data reported here to other types of learning, it does show clearly that disadvantaged children can succeed in at least one type of learning without one-to-one instruction. This is, so far as we know, the first clear demonstration of such an effect in a classroom setting. Its implications for instruction are obvious: for tasks which center on rote memorization, instruction in a whole-class setting is not only less expensive and less time-consuming than individual instruction, but it is also more effective. Exactly why this is so is not immediately determinable from the data collected in this study. In small groups, each child received not only his own

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training trial, but also observed each child in the group receiving a similar trial. Hence, for each trial which was received in individual training, approximately four trials were received in group training. However, the whole-class Ss received all of their training in whole-class activities, with a minimum of individual instruction by the teachers, yet they still performed better than either the individual or small-group Ss. There is some possibility, however, that repetitions to which the whole-class Ss were exposed exceeded those heard by either of the other two sets of subjects. To test whether number of repetitions alone was the significant variable in rote memorization, an additional study is required, with control over the number of both active (S produces the response) and passive repetitions (S hears, but does not produce the response). A second factor which may account for the superiority of class instruction was the use of the song, which was not included in the individual or small-group instruction. Rhythmic material is known to be easier to learn than prose (McGeoch, 1942, p. 158); in this study the song (melody) may have provided a structure which facilitated storage and retrieval of the picture-sound associations. This hypothesis should be tested in a class setting, comparing the use of the song to various other whole-class techniques.

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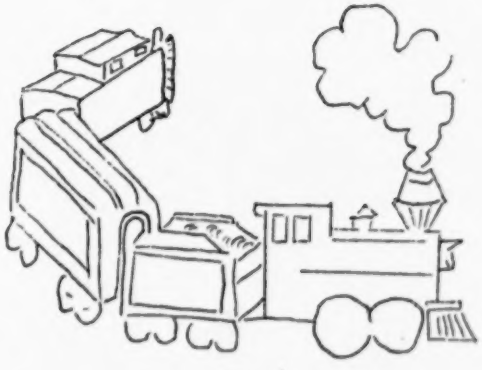
Appendix A
The Stimulus Pictures

Picture No.	Sound	Picture No.	Sound
1	/u/	7	/ɪ/
2	/m/	8	/š/
3	/z/	9	/x/
4	/r/	10	/o/
5	/e/	11	/g/
6	/s/	12	/a/



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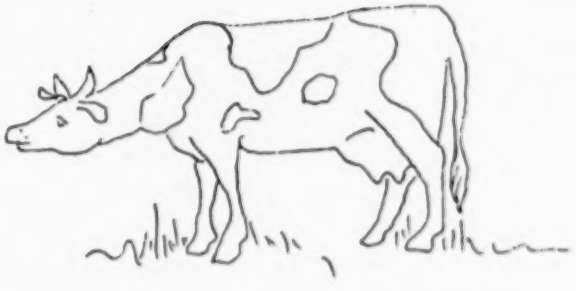

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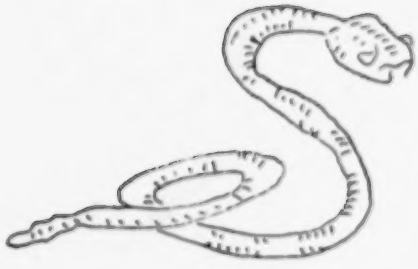
3

4

37

5



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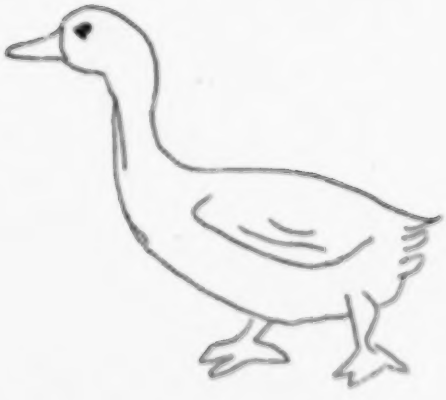
7

8

38

9

10



11

12

Appendix B
Narrative Stories

First Day

Danny is five years old. He is going to visit his uncle and aunt who live in the village. He has never travelled by train before. Everything he sees and hears is new to him. He listens to all the sounds. He hears something make the sound oo. What's that? oo. That's the train. When the train reaches the station or when it passes through a village it goes oo.

What goes m? That must be the cow out the window. m. The cow is eating grass. m.

z. "I know what that is. That's a bee." z. The bee goes z.

The train stops. Danny arrives at the village. He gets off the train and waits for his uncle. He hears r. "What is that?" That is a tractor. Danny's uncle is on the tractor. He has come to meet Danny. The tractor goes r.

Second Day

When Danny and his uncle get to the house on the farm Danny hears ai. That's the goat in the yard. The goat is greeting Danny. ai.

Danny stays outdoors while his uncle goes in. It is very quiet out in the yard. Suddenly he hears s. That's a snake which lives in the grass. s, says the snake. s.

When Danny goes into his uncle and aunt's house he hears a scream ee! That's his aunt. She has seen a little mouse, got scared and now she is standing on a chair shouting ee! She screams ee, but Ruth, Danny's cousin, says, "Mommy, be quiet. sh. Be quiet so Daddy can find the mouse. sh."

Where did the mouse go?

Third Day

The mouse disappeared in the garden. The cat goes ch (/x/). It's mad because the mouse disappeared. ch, says the cat. ch.

But why is Danny's aunt yelling oa? She hurt her finger. oa, she tried to use the hammer and hurt her finger. oa.

Danny goes out to the yard. There he sees the duck in the pool. q, says the duck. q. "What does the duck say?" Ruth answers, "The duck says hello in its language. q."

"Ah," Danny says. "Ah, I see, ah."

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